Overview and Analysis of Internet Protocol Television

[1]Junaid Qayyum, [2]Shahzad Rizwan, [3]Rashid Zubair, [4]Abdul.Sattar, [5]Usman, [6]M. Lal, [7]Shahzad Hameed, [8]Rashid Azim and [9]Asad Malook

[2]Institute of Business and Management Sciences, KPK Agriculture University, Peshawar, Pakistan
[1,3,4,5,6,7,8,9]Gandhara University of Sciences Peshawar, Pakistan
[1]junaidkhan2311@live.com

Abstract– Internet Protocol Television (IPTV) is a rapidly maturing technology for the delivery of broadcast TV and other media-rich services over a secure, end-to-end operator managed broadband IP data network. IPTV broadly encompasses a rich functionality that ranges from the acquisition, encoding and decoding, access control and management of video content, to the delivery of digital TV, movies on demand, viewing of stored programming, Personalized program guides, and a host of interactive and multimedia services. IPTV is distinctly different from "Internet Video" that simply allows users to watch videos, like movie previews and webcams, over the Internet in a "best effort" fashion with no into- end service management and quality of service considerations. This paper is an overview of the new emerging IPTV technology. Our future work will be focusing on IPTV Quality of Experience, its architecture, security threats and its possible solutions and so on.

Keywords– IPTV, Analysis, Protocol and Architecture

I. INTRODUCTION

With convergence becoming ever more prevalent in the average consumer's life, communication companies are vying for a spot on consumer's entertainment budget. The latest entry into the television programming industry are telecommunication companies - or telcos - which have started providing television programming over the internet commonly referred to as IPTV. IPTV is a system of classical TV signal broadcasting over computer networks using the IP protocol. Digital form of TV signal offers new possibilities and advantages for users and meets their requirements. This technology uses existing network structure and adds certain specific units (a streaming server, a content manager, a set-top-box) to the network system.

One of the most desirable features of IPTV is user interaction. This approach is impossible in a classical TV broadcasting. Users can request a concrete TV channel or a movie, they have a program offer in EPG (Electronic Program Guide), they can pay for demanded programs if they want to watch it through the system, there is ordering and paying possibility for advertising items, betting etc [2]. IPTV offers a lot and tends to be a universal system providing all services related to a television usage. In order to compete against cable's triple play, telecommunication companies started offering TV programming through their high speed Internet connection. This makes it possible for telcos to offer the quadruple play, which is a combination of wireless phone, Internet, land-line phone and TV programming. Figure 1 shows an IPTV quadruple scenario.

II. WHO OFFERS IPTV?

Verizon was the first telco to offer IPTV when it launched service in Keller Texas in Sept. 2005. Verizon's service starts at $39.95 a month. They plan on expanding into the 29 states where Verizon services are provided. Other telcos are taking Verizon's lead. AT&T joined the market in 2006 by offering U-Verse, which is a TV and Yahoo! Internet access for $74 a month. Currently, the U-Verse service is only offered in San Antonio and Houston, Texas. AT&T planned on expanding in 2007 and hopes to reach 19 million households by the end of 2008. Figure 2 shows the year wise revenue chart for telcos.

III. HOW IS IPTV DISPLAYED?

IPTV can be viewed in several ways. A computer may be used to reassemble protocol packets and convert them into a television signal that can be recognized by a standard television set. Another option is the set top box, commonly used by cable companies. The set top box would be used in place of a computer and would do the same job a computer does. Figure 3 shows an IPTV platform.

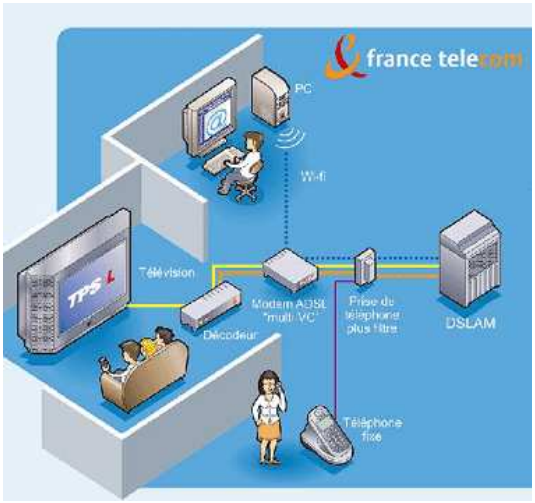

Fig. 1: IPTV Quadruple Scenario

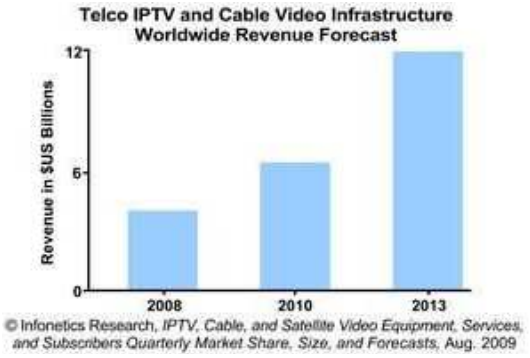

Fig. 2: Telcos Worldwide Revenue Chart

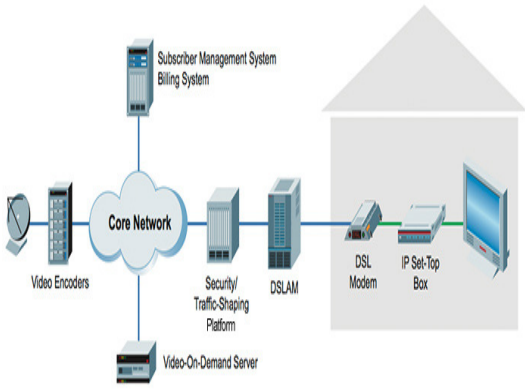

Fig. 3: IPTV Platform

IV. WIRELESS COMMUNICATION

Currently, none of the large telcos offer wireless IPTV. However, Ruckus Wireless, a wireless multimedia company based in California, has struck deals with several regional telcos to offer IPTV wirelessly. Ruckus has deals in place to provide wireless IPTV service in China and Ireland but has only recently signed deals with companies within the United States.

V. DIFFERENCES BETWEEN CABLE AND SATELLITE

There are several differences between traditional television programming, such as cable and satellite providers, and IPTV. At the moment, the biggest difference and the difference that may affect consumer decisions the most is the availability of HDTV programming. Cable companies are now offering several packages with HDTV programming. IPTV is not yet able to provide HDTV programming. Also, because IPTV is offered over the internet quality may be poor if the connection is not strong.

VI. IPTV - TECHNOLOGY OVERVIEW

The real-time nature of IPTV service prevents (in most cases) the network from performing retransmissions to correct errors; the end user's perceived quality of experience (QoE) may therefore be affected to various degrees. Independent studies have shown that contrary to voice service customers, IPTV subscribers, is not expected to compromise on the quality of their service, thus the signal quality across the IPTV network must be routinely tested or monitored to minimize and quickly resolve potential threats to service revenue.

Fig. 4: Eliminating video disruption and pixelization is the key to retaining subscribers

A. IPTV Network Topology

IPTV technology is part of a new breed of services designed to facilitate access to video entertainment. It provides access to digital TV over the IP transport medium from a head-end device to the end user's TV set-top box (STB). Most service providers use a dedicated transport network to support IPTV. Technically IPTV is the delivery of video content, Both Multi-channel and on-demand programming, on a closed system using Internet Protocol over a broadband connection to a television environment. [3]. A typical IPTV network is comprised of the following functional blocks (see figure below):

- *National head-end:* Where most of the IPTV channels enter the network from national broadcasters
- *Core network:* Usually an IP/MPLS network transporting traffic to the access network
- *Access network:* Distributes the IPTV streams to the DSLAMs
- *Regional head-end:* Where local content is added to the network
- *Customer premises:* Where the IPTV stream is terminated and viewed

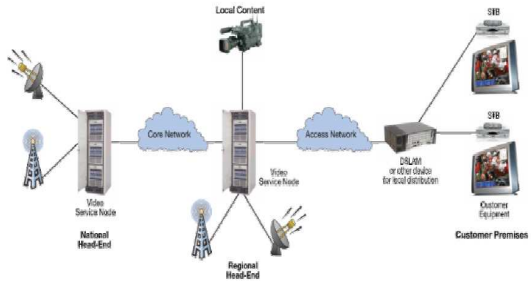

Fig. 5: General IPTV Network Architecture

Broadcast information coming from an antenna or a satellite dish at the national head-end is mainly distributed using MPEG-2 multi-program transport stream (or MPTS) to the video service node. Note that other more efficient, less bandwidth-hungry compression algorithms such as H.264 (MPEG-4 Part 10) or the Society of Motion Picture and

Television Engineers (SMPTE) 421M (also known as VC-1) are making their way to the marketplace to complement this first offering. The distribution of the actual SDTV or HDTV channel content is performed using various devices on the access network. Among these devices, digital subscriber line access multiplexers (DSLAM) as well as other technologies like fiber-to-the-home (FTTH) can be used to interface with the user's STB. For IPTV, each channel is distributed using a multicast IP address.

B. Factors Affecting Service

Table I presents the factors that affect the services.

Table I: Different Factors

Encoding and Compression	The quality of the video being distributed across the network can be affected right at the source; i.e., at the video head-end. The encoding and compression process usually creates a trade-off between the quality of the video and the desired compression level.
Jitter	Defined as a short-term variation in the packet arrival time, typically caused by network or server congestion. If the Ethernet frames arrive at the STB at a rate that is slower or faster, as determined by the network conditions, buffering is required to help smooth out the variations. Based on the size of the buffer, there are delivery conditions that can make the buffer overflow or underflow, which results in a degradation of the perceived video.
Limited Bandwidth	As core IP infrastructure is usually based on optical networks with a low level of congestion, bandwidth limitations (and the total amount of video-stream data that can be sent) is limited mostly by the access network or the customer's home network supported rate. When traffic levels hit the maximum bandwidth available, packets are discarded, leading to video quality degradation.
Packet Loss	Loss of IP packets may occur for multiple reasons—bandwidth limitations, network congestion, failed links and transmission errors. Packet loss usually presents a bursty behavior, commonly related to periods of network congestion.

C. Quality of Experience (QOE)

Due to the structure of Ethernet and IP networks, the quality of the video/audio traffic is primarily influenced by network jitter and packet loss. With the type of video encoding that is used in MPEG or other similar compression algorithms, the actual impact to the user perception depends on the packet type that is lost in the network. In MPEG-2, the transported packets that are used to form an image are divided into I-frames, P-frames and B-frames. In simple terms, I-frames contain a complete image, while P-frames and B-frames contain predicted information from the other frames [6].

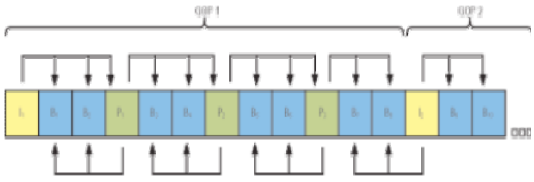

Fig. 6: Typical group of picture (GOP) related in MPEG

Fig. 3 provides a sample of the relationships between the various types of frames included in a group of picture (GOP). As shown, I-frames are independent and provide input to support the other frames; this means that an error in the I-frames will have more repercussions to the image being viewed than losing P-frames or B-frames.

1) Key QOE Parameters

Several metrics exist to quantify the impact of the network on the quality of the channel that is received by the end user. The most popular parameters are media delivery index (MDI) as well as PCR jitter for MPEG-2 TS. Other parameters are also used in the IPTV network, but they typically require further packet inspection to collect the information necessary for deeper analysis. IPTV is an evolving technology and it is not completely driven by specific standards for testing and monitoring. However, the aforementioned parameters must be measured as a first alert to help qualify the user's quality of experience (QoE) of the service delivered by the network over which IPTV services are being transported.

2) Media Delivery Index (MDI) as a Testing Metric

The nature of an IPTV service has inherent characteristics that are the primary drivers affecting the quality of the image being viewed; namely, bandwidth availability, packet loss and jitter. The use of MDI as a testing metric provides users the tools to measure and diagnose network-induced impairments for IPTV streaming media. MDI is the only standards-based (RCF-4445) video-quality metric available today and it is endorsed by the IP Video Quality Alliance. MDI is comprised of two distinct measurements: delay factor (DF) and media loss rate (MLR), which together provide a QoS measure of the delivered media stream that can be directly correlated to the end users' ultimate quality of experience.

Some of the key benefits of using an MDI:

- MDI does not perform any type of stream decoding to achieve its metrics and therefore does not require significant real-time processing power.
- MDI can be used with encrypted media payloads.
- MDI is not dependent on any one type of video-encoding technique, so it can easily be scaled to monitor video quality on hundreds of simultaneous channels.
- MDI is typically sampled at multiple points throughout the stream path with the measurements serving as indicators of problems in the network that can be proactively addressed before they become service-affecting issues.
- Since MDI relies on transport-layer metrics (DF and MLR), it can be used to set network margins and it directly correlates to impending network problems with respect to video quality [4].
- Since MDI uses packet-level metrics, it helps validate the performance of network equipment such as switches and routers that play a key role in determining whether a packet is delayed or dropped.

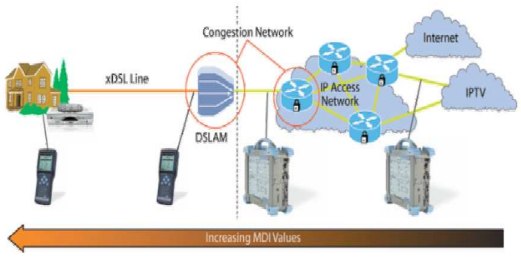

Fig. 7: Typical core-to-access IPTV testing application with media delivery index (MDI) measurement across the network

VII. ADVANTAGES OF IPTV

Other than wireless communication, another advantage of IPTV is that if the customer has quadruple play (internet, television, telephone, mobile phone service) with the same company, the cell phone can be used to schedule the recording of a program. Excluding cell phone service and having only three services with a company is referred to as triple play.

VIII. DISADVANTAGES OF IPTV

There are some limitations to IPTV. According to Wikipedia, because IPTV is based on the Internet Protocol, it is sensitive to packet loss and delays if the IPTV connection is not fast enough and it also does not support HDTV at the moment. AT&T is currently experimenting with HDTV and its U-Verse service in the Houston area according to Cable Industry Insider [5].

IX. CONCLUSION

Among the diverse areas within an IPTV solution, which are to be addressed, it is obvious that the standardization process related to it is in its early stages. In the different parts of the whole system, many entities are working. However, so far, the observation is that there is little coordination among them. After issuing a standard offer, it can be observed that one component of a system is a good step forward, but too little. Now for IPTV the need of the hour is to gain mass acceptance and to reach to the optimum technical and commercial success as per everyone's expectation. In order to achieve this, the IPTV market must make it free from closed solutions, which may hamper the following three goals: innovation, development, and competition. In regards to the future of IPTV, it can only follow one path, which is close to what the market has witnessed in the traditional broadcast world. Moreover, it is important to note that this market has built an open system, which is well defined and relies on open standards. To make IPTV successful and perfect as per expectations, it has to guarantee the interoperability between all the building blocks. But, the conformance program related to it is critical.

REFERENCES

[1] http://seminar-report.blogspot.com/2008/09/iptv-abstract.html
[2] HARTE L., Athos, Inc., *Introduction to IP Television (IPTV)*, 2005, ISBN 193281335-7.
[3] Amy Harris and Greg Ireland, "Enabling IPTV: What Carriers Need to Know to Succeed," IDDC White Paper, May 2005.
[4] IBID, 2005.
[5] http://www.exfo.com.
[6] http://downloads.lightreading.com/wplib/heavyreading/IPTV_QOE.pdf.